Architectures of Next Generation Wireless Networks

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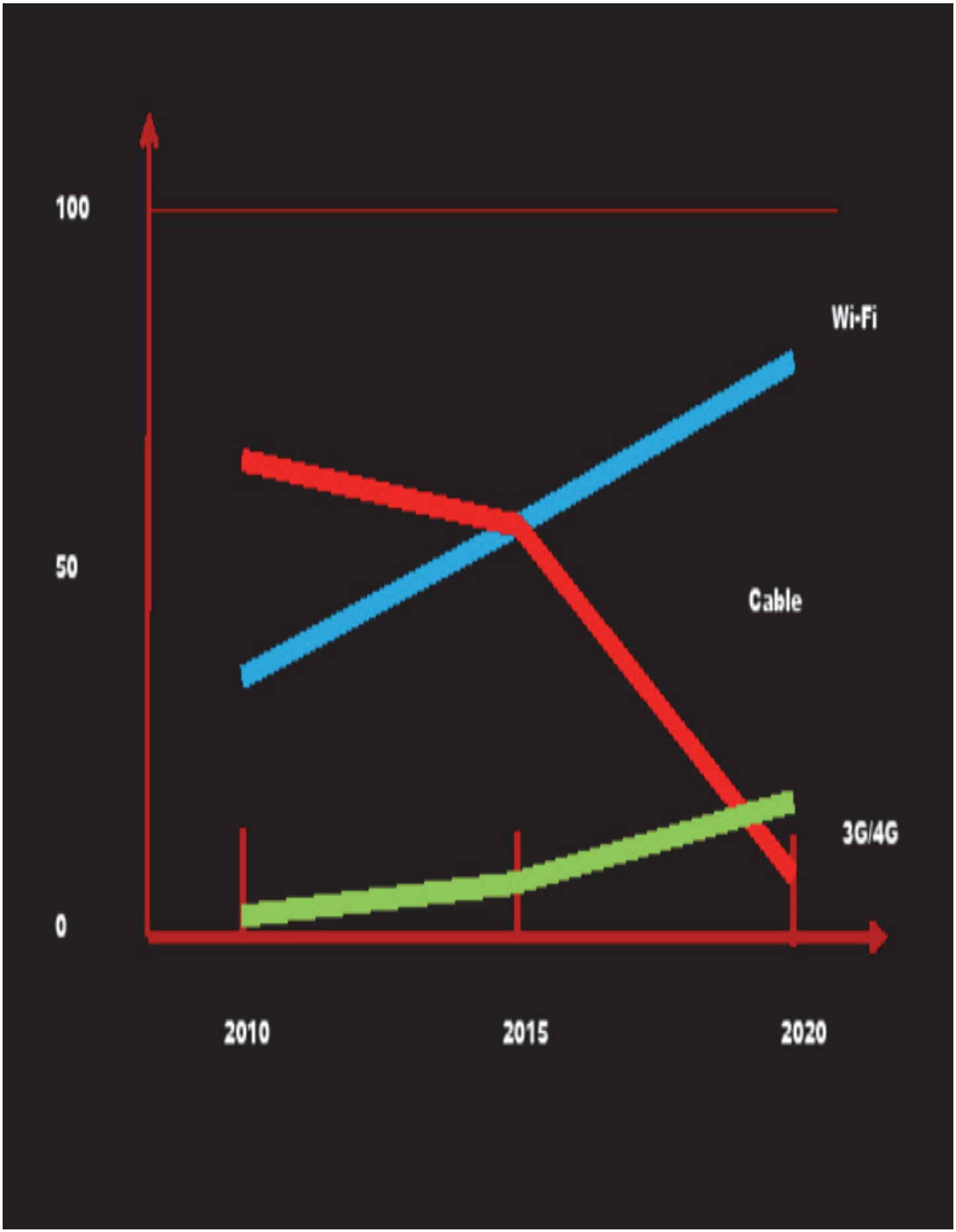
- **Internet is increasing exponentially:**
  - **2001: 180 million users**
  - **today: more than 2 billions users**
- **Internet traffic and the bandwidth double every 18 months**
- **The bandwidth is about 100 Tbits/s**
- **More wireless voice traffic than wired traffic**
- **=> non-packet based traffic are encapsulated in data packet traffic (Internet)**
- **=> Multiple access technologies (ADSL, 4G, …)**

- CTI (Computer Telephony Integration)
  - PC: intelligence in the computer
  - telephony: intelligence in the network
  - => to reach a compromise
- Switched telephony network (TDM) => IP NGN networks (Multiservices Convergent Network)
- Modem triple play (voice, data, TV)
- Quadruple play: triple play + mobile telephony (Wifi and 3/4G)
- Virtualization of the access point. Green networks
- IMS (IP Multimedia System) architecture: full IP architecture



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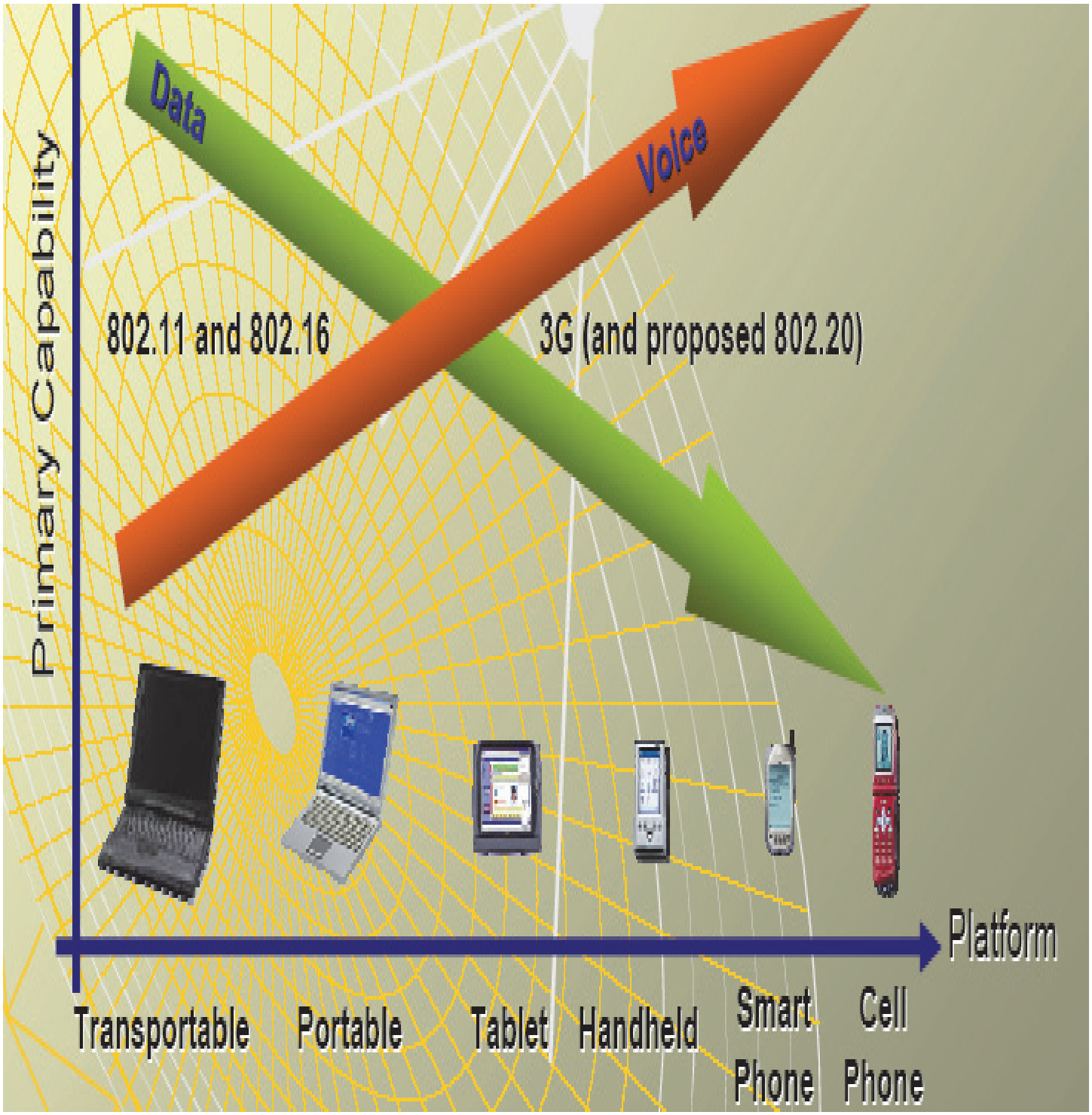

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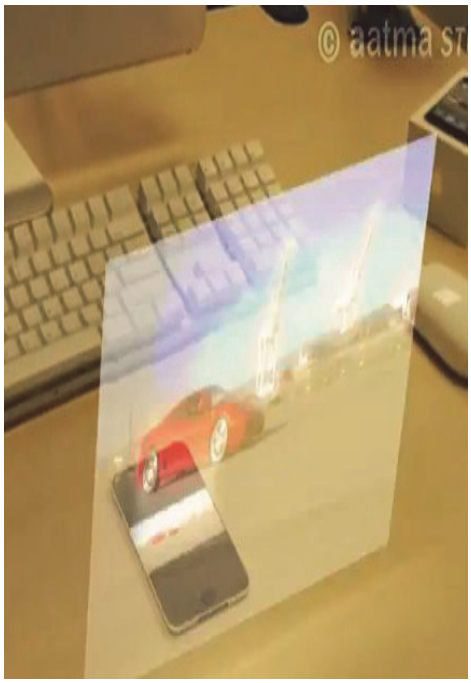
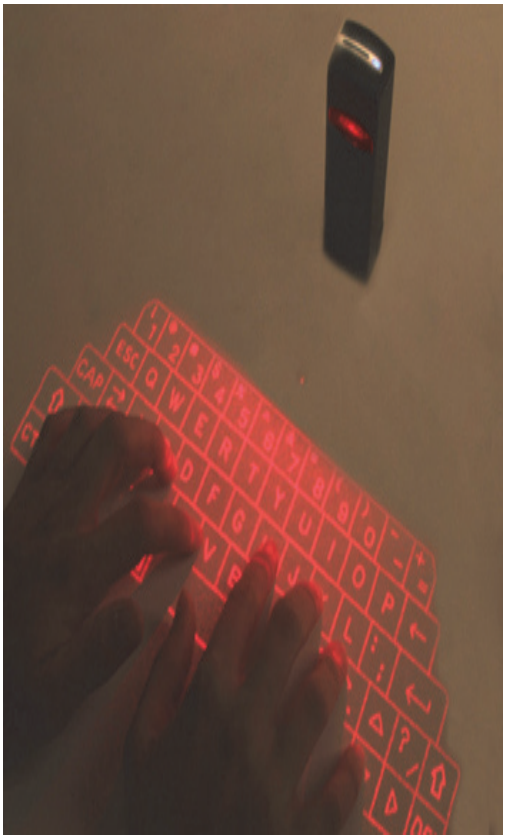
Flexible Organic Light Emitting Diode (OLED) – Holographic / Laser keyboard





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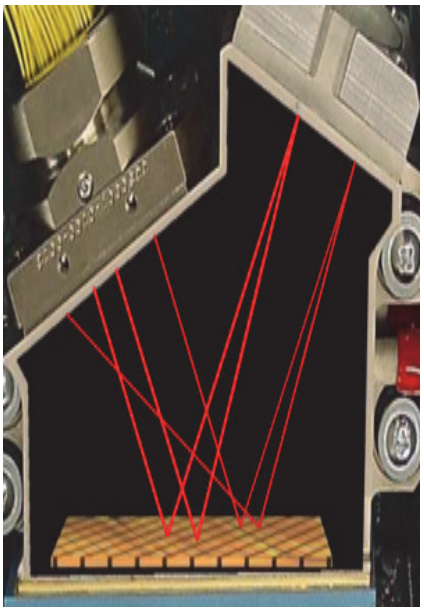
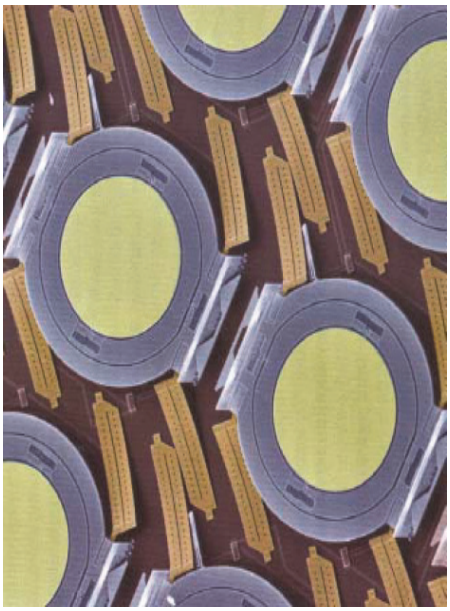
- optical switching
- 256 mirrors
- Diameter: 0,5 mm
- Micro Electro Mechanical Systems (MEMS)

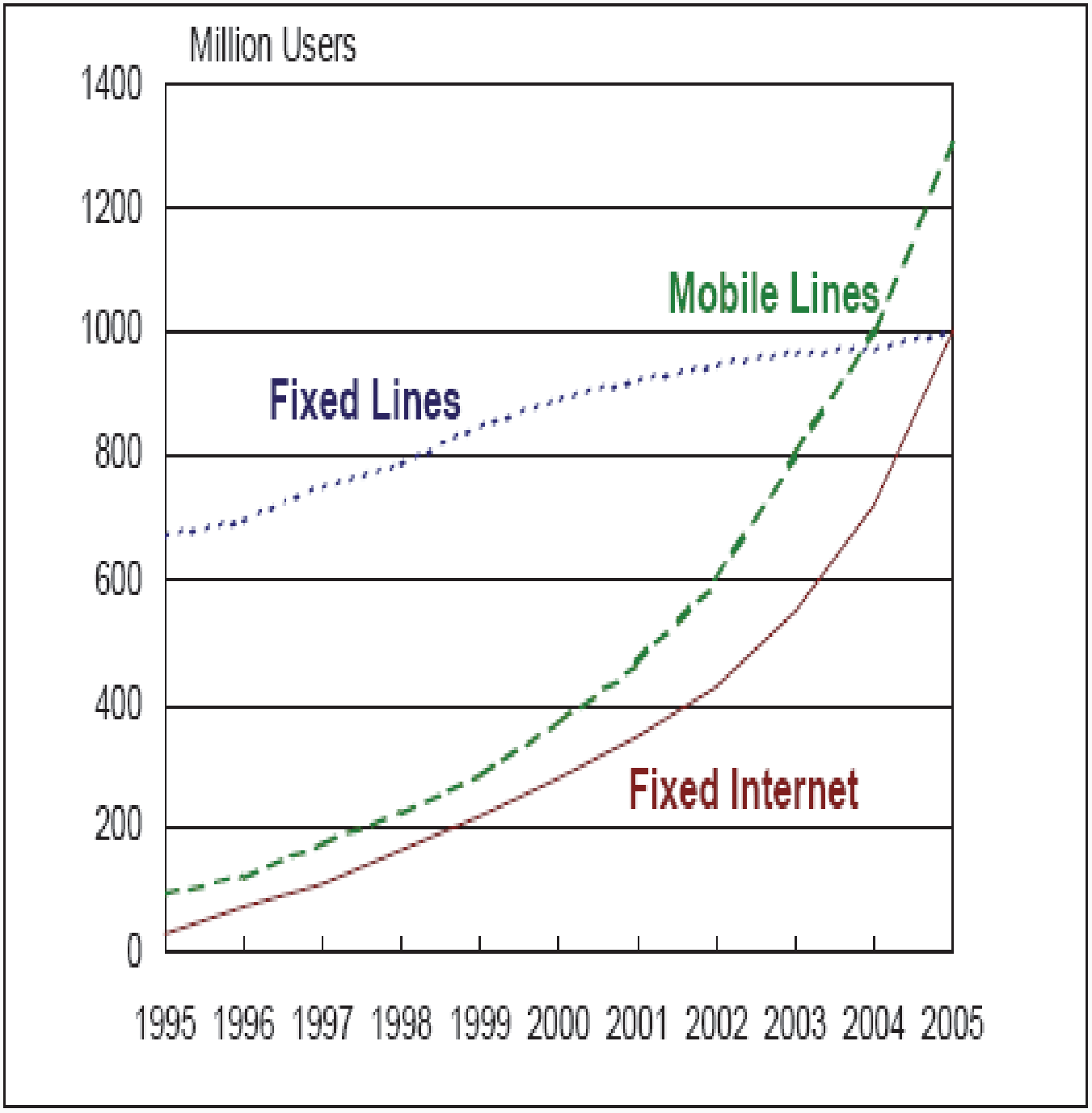




- Global Internet: GEO, MEO, LEO
- 4G: LTE-A
- 3G: UMTS, CDMA2000, …
- 2G: GSM, GPRS, EDGE, PDC, …
- Hot Spots: WiFi
- PAN: Bluetooth, Ad Hoc, …
- Wired networks: ADSL, PSTN, …
- => Multimedia mobile applications will create an united common platform that incorporate different services.
- => QoS (time, bandwidth, reliability, …) and security problems within heterogeneous networks

QoS

- Terminals (batterie (hydrogen, supercondensator, …) , screen size, processor, ….)
- Blind spots
- Handover
- Each wireless networks offer different QoS



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Multiple Access Techniques

1G: FDMA (analogical)

2G: TDMA (numerical)

3G: CDMA

4G: OFDM (Orthogonal Frequency Division Multiplexing)

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Satellite Transponders

- LEO (Low Earth Orbit) use the Ka band

- MEO (Medium Earth Orbit),

- GEO (Geostationary Earth Orbit).

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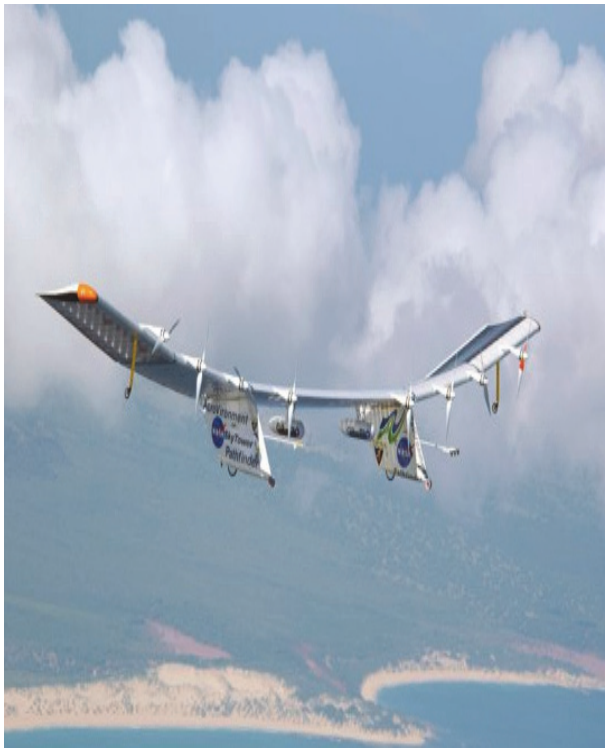
- Pico-satellite: 1 kilo, 340 km
- HEO (Highly elliptical Earth Orbit)
- HAPS (High Altitude Stratospheric Platform):

+Proteus airplane (Awacs) will offer a bandwidth of 164 kbit/s for a 100 km diameter

+ Airship at an altitude of 23 km (Sky Station project). Rate of 10 Mbit/s in the 48 GHz band.



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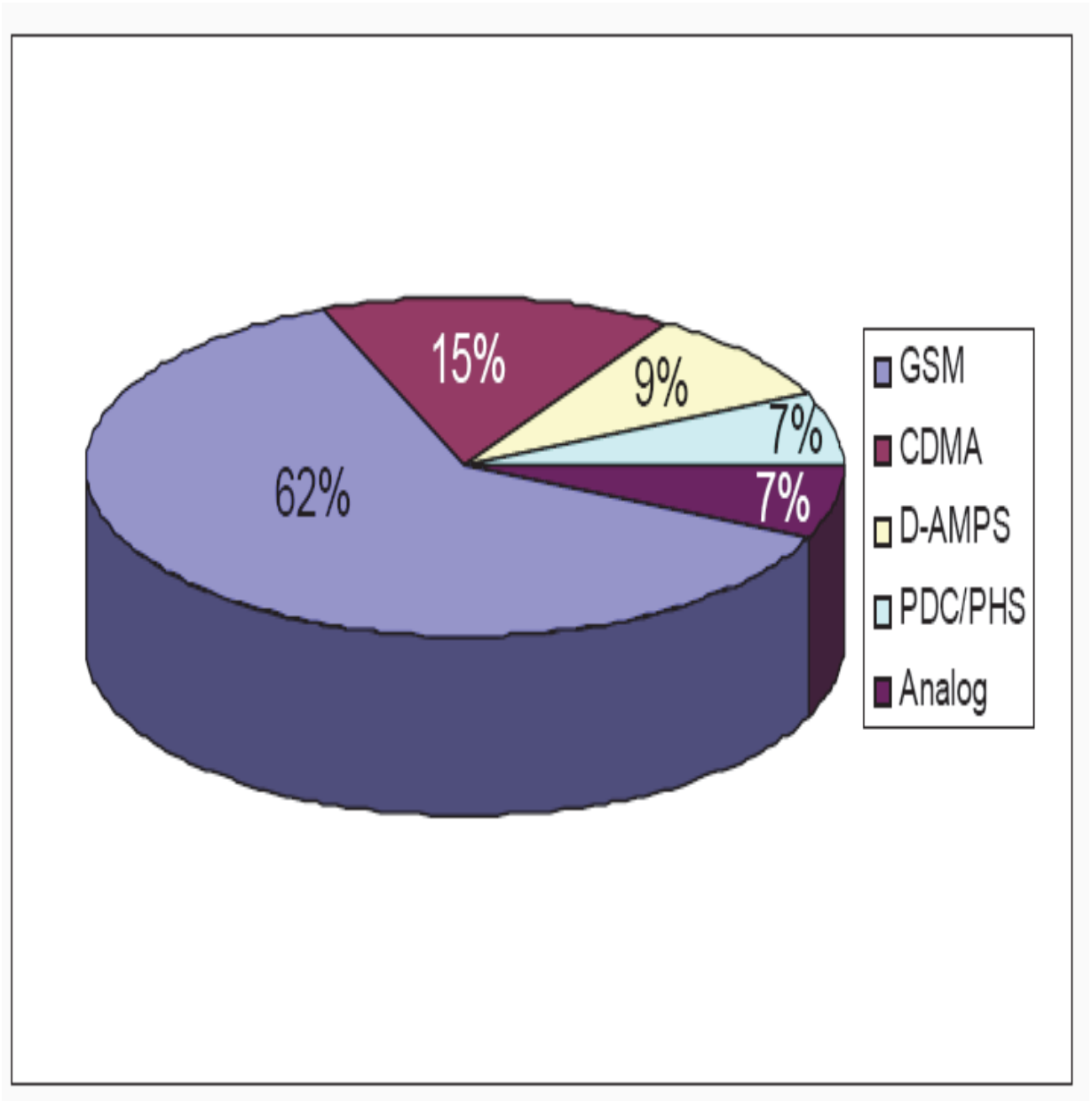
Telephony



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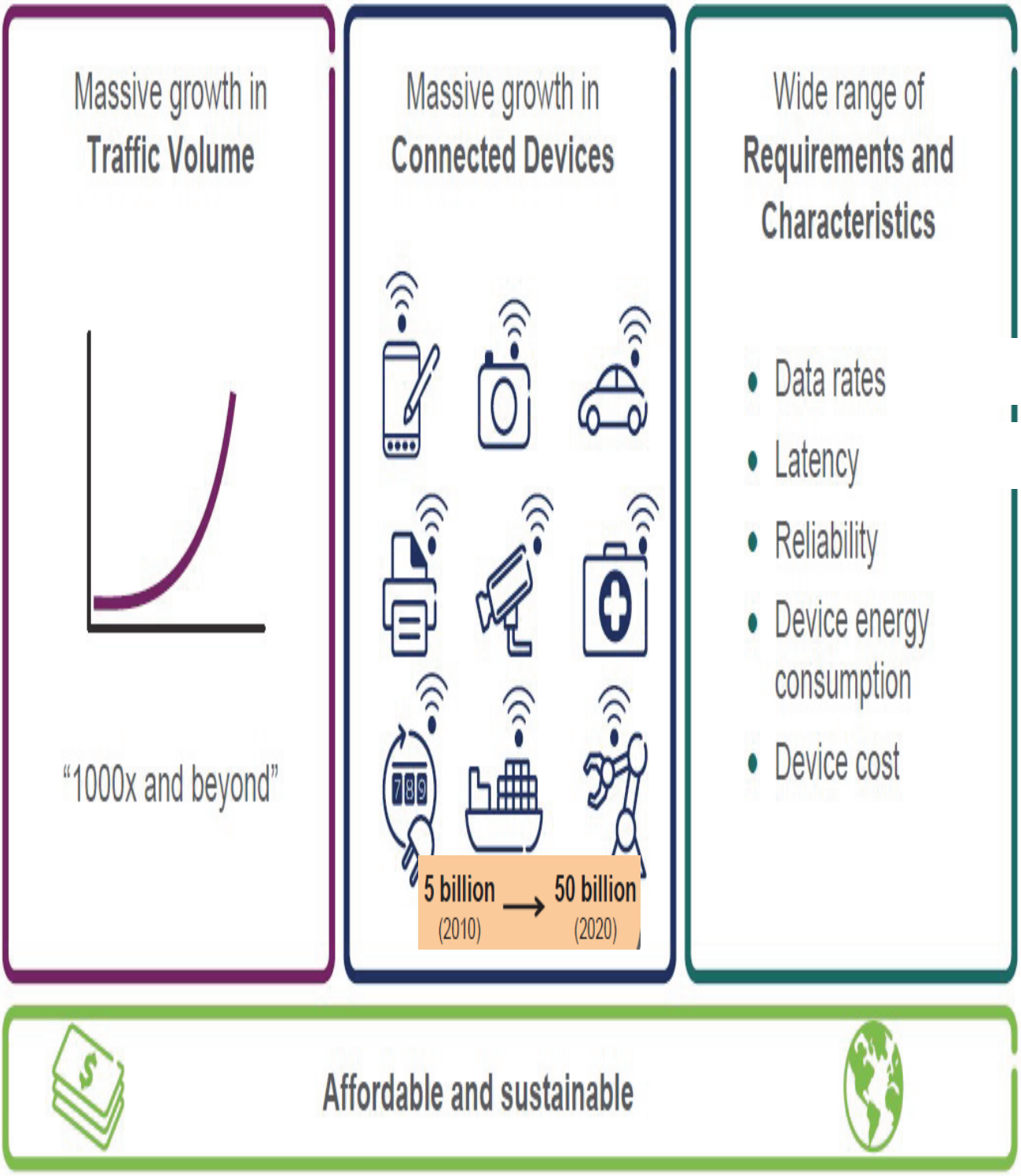

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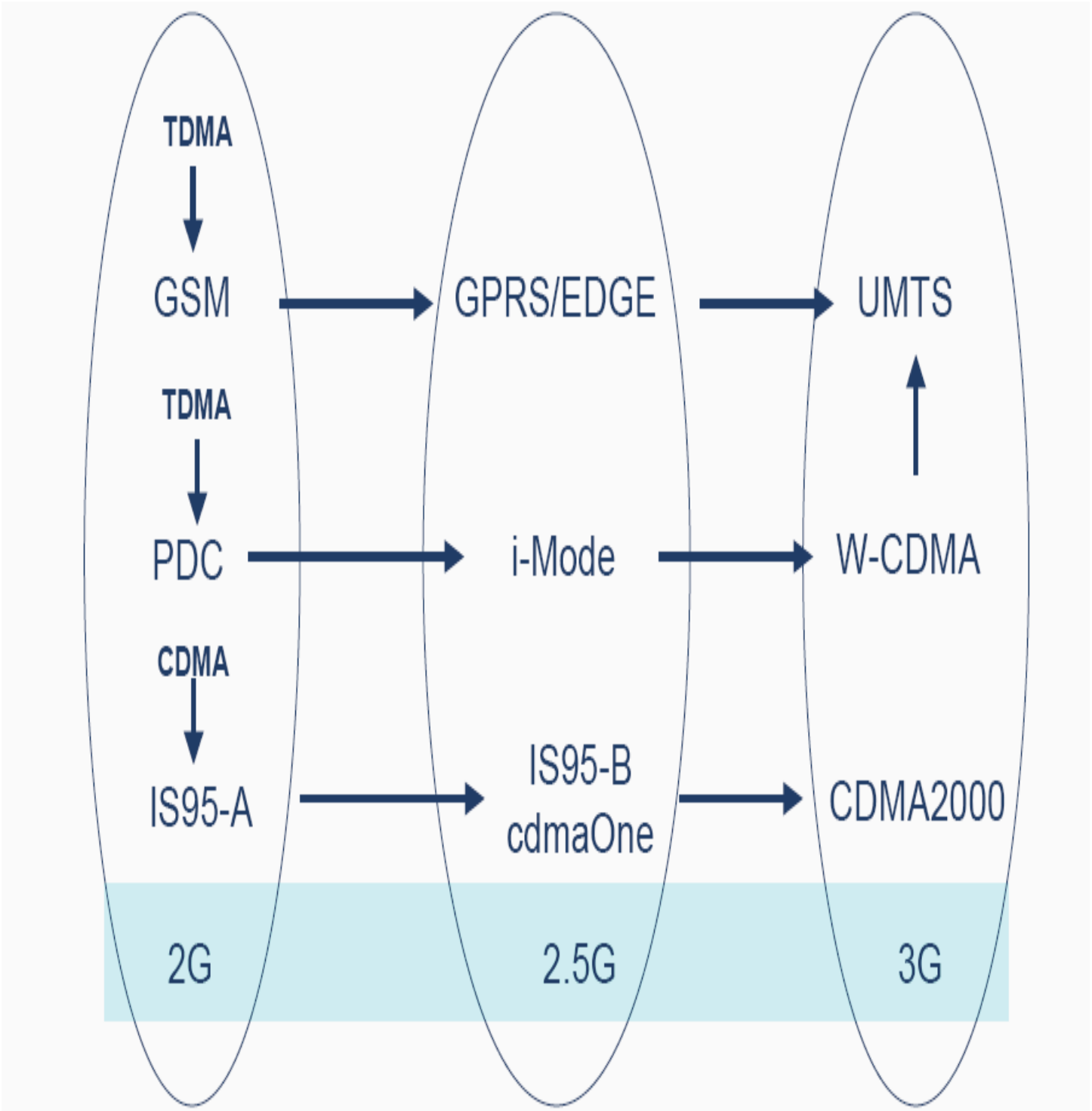

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- New frequency and new infrastructures
- 3G UMTS: 384 kb/s
- 3,5G: HSDPA (High Speed Downlink Packet Access) => 1Mbit/s
- 3,75G: HSUPA High-Speed Uplink Packet Access => 4 Mb/s
- 4G: 2010 will use the 30 GHz frequency : 300 Mb/s LTE-A/B (Long Term Evolution)
-5G: =>2020 50Gb/s

IEEE 802 wireless standards

- 802.15 WPAN, since 1999 (RFID, ZigBee, Bluetooth, UWB, Wimedia)
- 802.11 WLAN, since 1990 (WiFi)
- 802.16 WMAN, Wireless Local Loop, since 1999 (WiMax)
- 802.22 WRAN

- There is no single technology that can satisfy all needs . Family of complementary technologies and devices

Wireless Personal Area Networks (WPAN) IEEE 802.15

- RFID (Radio Frequency Identification), NFC
- IEEE 802.15.1 : Wireless Personal Area Network (Bluetooth). Rate 1 Mbit/s, 2400MHz. 10 meters
- IEEE 802.15.3: High rate 400 Mbit/s WiMedia Ultra WideBand (UWB) is a wireless technology for transmitting digital data over a wide spectrum of frequency bands with very low power, WUSB (Wireless USB) => 480 Mb/s
- IEEE 802.15.4: 200 kb/s, communications between toys, sensors (ZigBee), low complexity, low power consumption

New IEEE 802.11 ng projects

- 802.11k for radio resource management to achieve optimized use of radio resources
- 802.11r – Fast roaming
- 802.11s – Mesh networks (improving WiFi with AdHoc) => mobile hotspot
- 802.11u – Wireless Interworking with External Networks (WIEN)
- 802.11ah 1km smartgrid. Slow
- 802.11af Cognitive radio 10 or 20 meters (Utilization of TV frequencies)
- 802.11ac – Beamforming <6Ghz 500 Mb/s. Directional transmissions
- 802.11ad - Very High Throughput in 60 GHz 10 meters. WiGig (Wireless Gigabit Alliance) => 6 Gbit/s

Next Generation Internet

- MPLS, Native IP, Carrier Grade Ethernet
- Unique network: wired and wireless, data, voice
- Problem of TCP/IP: electrical consumption, complexity
- Intelligence in the network: smart, active autonomic networks => autoconfiguration
- Vitual Internet: Cloud and Data Center